

Rocky Mountain Research Station

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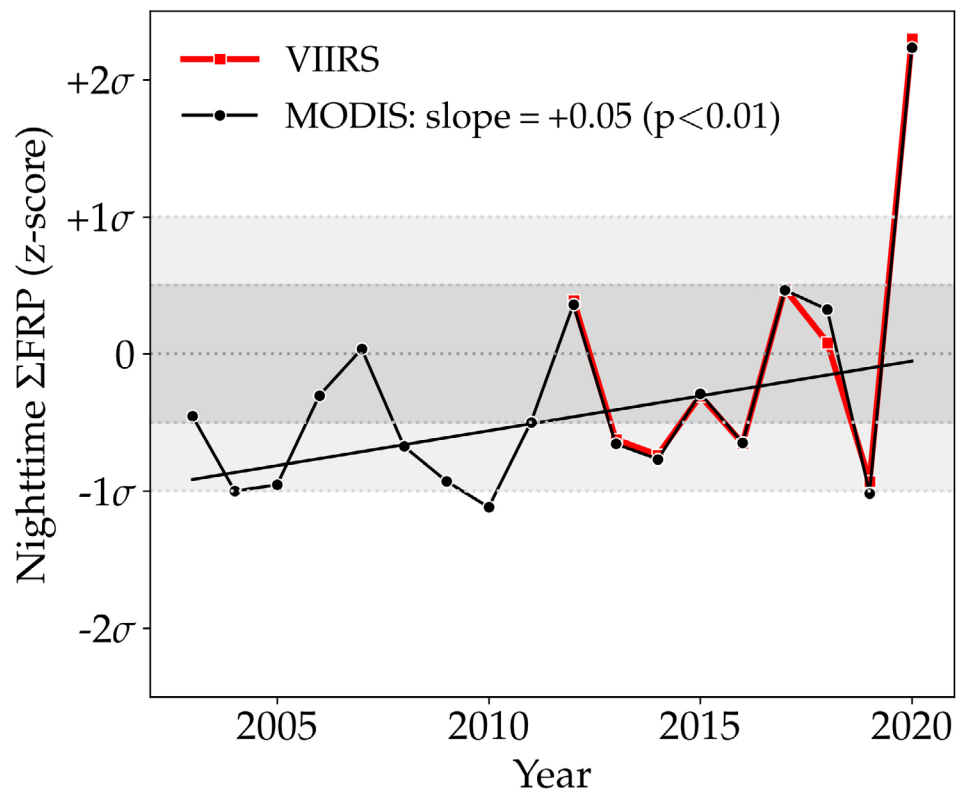
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Nighttime Fire Activity Is on the Rise in the United States: Posing Greater Risks to Firefighters and Communities

Firefighting crews count on a dampening of fire activity at night, thanks to a temperature drop and rising humidity, for much-needed respite and a chance to regroup for the next day's efforts. However, a newly published study by Rocky Mountain Research Station fire scientists Patrick Freeborn and Matt Jolly and collaborators has found that the usual nighttime dampening of fire activity may be changing. Using satellite remote-sensing data from the heat-sensitive instrument MODIS, the researchers found that nighttime fire activity has increased as wildfires have grown larger. Understanding the potential for a wildfire to continue burning through the night has important implications for both firefighter safety and impacts to communities.

This study used nearly two decades (2003–2020) of satellite data to characterize the dynamics of wildfires during the day and night across the continental United States. These satellite observations were split out according to vegetation type, wildfire size, and time of detection. Whereas daytime fire activity was widely detected



This graph shows the increasing trend in nighttime fire activity (nighttime fire radiative power, FRP, as measured in millions of megawatt units, MW) observed since 2003 across the continental United States. USDA Forest Service graphic by Patrick Freeborn.

across the continental United States within wildfires, prescribed burns, and agricultural fires, nighttime fire activity was concentrated inside wildfires, and particularly within large wildfires in the western United States. An analysis

of moisture levels of 1,000-hour fuels indicated that as fuels dried out, the satellites detected less agricultural and prescribed fire activity and increasingly larger and more intense wildfires with higher chances that the fires would

persist overnight. Over the past 18 years, significant increasing trends in nighttime wildfire activity were detected as wildfire size has grown larger.

One potential reason for this trend is that the air over most of the western United States has become drier and warmer at night over the past 40 years, influencing the rate at which vegetation and other fuels for fire will dry out and burn. Increased nighttime wildfire activity means that firefighters are exposed to the risks of working in the dark and have less opportunity for rest and recovery. “As wildfires grow larger, we expect to see increases in nighttime fire activity or intensity and this can impact both firefighter safety and community preparedness,” Freeborn says. “This increased nighttime fire activity may have negative impacts on our ability to manage and contain wildfires.”

FURTHER READING

Freeborn, P.H.; Jolly, W.M.; Cochrane, M.A.; Roberts, G. 2022. [Large wildfire driven increases in nighttime fire activity observed across CONUS from 2003–2020](#). *Remote Sensing of Environment*. 268: 112777.

Freeborn, P.H.; Jolly, W.M.; Cochrane, M.A. 2016. [Impacts of changing fire weather conditions on reconstructed trends in U.S. wildland fire activity from 1979 to 2014](#). *Journal of Geophysical Research: Biogeosciences*. 121: 2856–2876.

Jolly, W.M.; Cochrane, M.A.; Freeborn, P.H.; Holden, Z.A.; Brown, T.J.; Williamson, G.J.; Bowman, D.M.J.S. 2015. [Climate-induced variations in global wildfire danger from 1979 to 2013](#). *Nature Communications*. 6(1).

LEAD SCIENTISTS

Patrick Freeborn is a Research Physical Scientist at the Rocky Mountain Research Station Missoula Fire Sciences Laboratory. His research interests focus on the thermal remote sensing of wildfires, ranging from combustion experiments at the laboratory scale to long-term monitoring at the continental scale.

Matt Jolly is an Ecologist in the Fire, Fuel, and Smoke Science Program at the Missoula Fire Sciences Laboratory. His research focuses on improving our understanding of how living plants burn and how live fuel flammability varies both seasonally and interannually.



An increase in nighttime wildfire activity means that firefighters are exposed to the risks of working in the dark and have reduced opportunities for rest and recovery. USDA Forest Service photo by Meghan Fluharty.

Key Management Implications

- Nighttime fire activity has been increasing since 2003.
- The majority of nighttime fire activity detected by satellites from 2003 to 2020 occurred in larger wildfires burning during drier conditions.
- Increasing nighttime fire activity can be directly translated to increasing nighttime fuel consumption and nighttime smoke production.
- Analysis of 1,000-hour fuels indicated that as they dried out, the satellites detected increasingly larger and more intense wildfires with higher chances that the fires would persist overnight.
- This increase in nighttime fire activity may negatively impact the safety of firefighters and the ability of communities to prepare for and respond to wildfire.

The Rocky Mountain Research Station is one of seven units within USDA Forest Service Research & Development. RMRS maintains 14 field laboratories throughout a 12-state geography encompassing parts of the Great Basin, Southwest, Rocky Mountains, and the Great Plains. While anchored in the geography of the West, our research is global in scale. RMRS also administers and conducts research on 14 experimental forests, ranges and watersheds and maintains long-term research databases for these areas. Our science improves lives and landscapes. More information about Forest Service research in the Rocky Mountain Region can be found here: <https://www.fs.usda.gov/rmrs/>.

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